PATENT SPECIFICATION 805,789

Inventor :—ALEC HIBBURD LAURIE.

Date of filing Complete Specification : Feb. 4, 1957.

Application Date : Nov. 2, 1955. No. 31333/55.

Complete Specification Published : Dec. 10, 1958.

Index at Acceptance :—Class 133, K.

International Classification :—B63b.

COMPLETE SPECIFICATION.

Improvements in Artificial Breakwaters.

We. PNEUMATIC BREAKWATERS L——

ERRATUM

SPECIFICATION NO. 805,789

Page 1, in the heading, *for* "Index at Acceptance:- Class 133, K." *read* "Index at Acceptance:- Class 113, K.".

THE PATENT OFFICE,
27th May, 1959

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[illegible] gross discontinuities in the water, in the form of eddies whose velocity and magnitude are of the same order as that of the movements of water in orbital motion, in order to create such conditions in the water it is necessary to generate large bubbles, that is to say bubbles substantially larger than are formed in liquid at an air nozzle through which air is being discharged continuously.

In the present invention the basic ingredients of an artificial or pneumatic breakwater are as follows : a supply of air or other gas from a compressor or other available source is conveyed say to the sea bottom through a corrosion resisting pipe of suitable bore. This pipe is fitted with adjustable valves spaced some appropriate distance say three feet apart. The function of these valves is to provide, at the specified intervals an air or gas discharge which is controllable and preferably constant for each outlet, notwithstanding the effects of pressure drop in the length of pipe, or differences in hydrostatic pressure caused by variations in the contour of the sea bottom. The valves terminate in jets or outlets which project substantially vertically from the main pipe.

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[illegible] of the casing. This tube, which is hereafter called the air delivery tube, is in turn surrounded by a cylinder of slightly greater internal diameter which is located so that the top of the cylinder is slightly below the roof of the casing and the bottom of the cylinder slightly below the bottom of the delivery tube. The bottom of this cylinder is capped suitably with polythene material from which the cylinder, can and tube are conveniently made. An air supply is fed into any part of the main body of the distributor outside the cylinder.

The action of the distributor is as follows : Starting with the distributor full of water, air is introduced, which rises to the top and is prevented from escaping by the closed top of the outer casing or can. The water in the main casing goes out through the open bottom, while the water in the cylinder which is closed at the bottom escapes through the air delivery tube.

When the water level has dropped, owing to displacement by air, to the level of the bottom of the air delivery tube, some air starts to escape up the tube, entraining the water therein. and almost immediately there ensues a sharp discharge, in the form of a

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COMPLETE SPECIFICATION.

Improvements in Artificial Breakwaters.

We, PNEUMATIC BREAKWATERS LIMITED, of 9 Upper Grosvenor Street, London, W.1, a Body Corporate duly organised under the laws of Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to artificial breakwaters that is to say to devices for reducing sea waves and swell by interposing air or other bubbles in the path of wave motion.

Air or other gaseous bubbles are considered to be effective for this purpose only insofar as they create gross discontinuities in the water, in the form of eddies whose velocity and magnitude are of the same order as that of the movements of water in orbital motion, in order to create such conditions in the water it is necessary to generate large bubbles, that is to say bubbles substantially larger than are formed in liquid at an air nozzle through which air is being discharged continuously.

In the present invention the basic ingredients of an artificial or pneumatic breakwater are as follows : a supply of air or other gas from a compressor or other available source is conveyed say to the sea bottom through a corrosion resisting pipe of suitable bore. This pipe is fitted with adjustable valves spaced some appropriate distance say three feet apart. The function of these valves is to provide, at the specified intervals an air or gas discharge which is controllable and preferably constant for each outlet, notwithstanding the effects of pressure drop in the length of pipe, or differences in hydrostatic pressure caused by variations in the contour of the sea bottom. The valves terminate in jets or outlets which project substantially vertically from the main pipe.

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Over each of these jets is placed, on supporters, a distributor comprising a container, vessel or can, of cylindrical, rectangular or other suitable cross section, a particular feature of which is that the upper end of the can is closed, while the lower end is open to the sea. The can is also fitted with a discharge pipe arranged in such a manner as to operate like an inverted siphon.

In one embodiment each distributor consists of an outer casing, which is closed at the top and open to the sea at the bottom. Into the top is inserted a tube of suitable diameter, which projects downward into the casing to a distance slightly short of the depth of the casing. This tube, which is hereafter called the air delivery tube, is in turn surrounded by a cylinder of slightly greater internal diameter which is located so that the top of the cylinder is slightly below the roof of the casing and the bottom of the cylinder slightly below the bottom of the delivery tube. The bottom of this cylinder is capped suitably with polythene material from which the cylinder, can and tube are conveniently made. An air supply is fed into any part of the main body of the distributor outside the cylinder.

The action of the distributor is as follows : Starting with the distributor full of water, air is introduced, which rises to the top and is prevented from escaping by the closed top of the outer casing or can. The water in the main casing goes out through the open bottom, while the water in the cylinder which is closed at the bottom escapes through the air delivery tube.

When the water level has dropped, owing to displacement by air, to the level of the bottom of the air delivery tube, some air starts to escape up the tube, entraining the water therein, and almost immediately there ensues a sharp discharge, in the form of a

siphoning action, of all the air in the main casing. The air in the main casing is driven out through the closed cylinder, and thence through the air delivery tube by the pressure difference of the water inside and outside the casing and is immediately replaced by sea water which enters through the open bottom of the casing. When the air discharge is complete the siphoning action stops and the casing starts to fill again with air. Since the air supply to the casing is continuous, the cycle described above repeats itself with a frequency which is proportional to the rate of air feed. The intermittent discharge of air emerges from the delivery tube in the form of large bubbles which are then free to find their way to the sea surface, and in so doing to bring about a state of random turbulance in the water. The provision of a concentric pair of tubes, viz. the air delivery tube and the cylinder capped at the bottom are a convenient practical substitute for a U tube.

There is also provided a pair of grids or sieves, for the purpose of preventing seaweed and marine animals from choking the syphon system. One of these grids covers the air delivery outlet on top of the distributor, while the other surrounds the top of the siphon system inside the container.

A more effective air discharge, occupying a shorter time interval is secured if the siphoning action is prevented from completing itself, that is to say if the air discharge is stopped at the point where the water level in the casing reaches the top of the cylinder or closed-bottom-tube, and is not allowed to flood concentric tubes by water running into these from inside the container.

In order to secure abbreviated siphoning action, provision has been made to stop or at least substantially decelerate the flow of water into the concentric tubes, as follows : round the closed-bottom-tube, but above an internal grid is fitted a small piece of buoyant, tubing whose inside diameter is slightly greater than the outside diameter of the former. This piece of tubing carries an annulus of lightweight material. The action of this fitting is as follows : when the casing is being filled with air, and the water level drops below the inner grid, the fitting drops on to the grid, and remains there until the siphoning action causes the water to rise again inside the casing. When the water reaches the fitting it entrains it upwards, by virtue both of its buoyancy and of the impact of water on the annulus, with the consequence that the fitting is brought smartly up against the roof of the casing. In this condition the tubular part of the fitting is brought into a position where it occludes the entrance to the closed bottom tube part of the siphon, and while some water will leak past the clearance between the fitting and the tube, there is insufficient flow to expel the air from the tube. Concomitantly with the slackening of flow in the siphon system, the residual air in the delivery tube emerges into the sea, and is replaced by a downrush of water which in turn forces the air in the closed bottom tube back into the main container. As soon as the further ingress of air into the container lowers the water level, the fitting drops again, thus leaving a clear passage for the next siphoning action.

As regards the main air supply, each container is supplied with compressed air or other gas, in one of two ways, according to circumstances ; either a jet of appropriate calibre projects into the casing from a main supply pipe, or each container is supplied individually from the compressor by a small gauge pipe, whose air delivery can be controlled.

The distributor described above serves to discharge intermittently a large volume of air during a short period. Ideally each discharge should take the form of a single large bubble, though in practice this seldom happens. As an aid to the formation of the maximum size of bubbles at each discharge, provision is also made for the injection into the main air line or lines of an aqueous solution of a suitable surface active agent, which travelling down the air line in the form of a mist, alters the tension in the water immediately above the air delivery tube and assists in the formation of larger bubbles.

The aforementioned embodiment is illustrated in the accompanying drawing which is a part sectional side elevation of the can. This is a circular cylindrical container 1 of polythene, open at the bottom and closed at the top 2 except for a central aperture 3.

The container rests on four legs 4 which are braced at 5 and have feet 6 suitable to stand on the sea bottom.

It will be understood that air or other fluid is fed to the container by a pipe line or header running along the sea bed and having a riser to each of the cams, preferably leading into the open bottom thereof.

In the aperture 3 is a depending tube 10 having an open bottom and surrounding this tube 10 is a slightly larger tube 11 having a closed bottom 12 and spaced from the closed top, it being appreciated that the container and tube system constitutes a siphon.

Slidable on the outer tube 11 is a flanged ring or valve 14 suitably a buoyant tubing, the function of which is as follows : when the can is filled with air and the water drops below the inner grid 15, the valve 14 drops onto the grid. When the water rises in the casing it carries the valve 14 with it which occludes the entrance to the siphon. 16 is an upper grid or grill protecting the central aperture 3.

WHAT WE CLAIM IS :—

1. An ejector for a pneumatic breakwater operated by the supply of air or other gas characterized in that it comprises a container which is so designed that by a siphon effect an intermittent discharge of air or other gas takes place in the form of large bubbles which inhibit wave motion in the ambient sea water or other liquid.

2. An ejector for a pneumatic breakwater according to the preceding claim wherein the container is closed at the top except for a central aperture, and open at the bottom, and has a depending tube in said aperture, a second tube surrounding said central tube and spaced therefrom within the container, said second tube having a closed bottom and being spaced from the top of the container.

3. An ejector for a pneumatic breakwater according to either of the preceding claims mounted on legs or supports and having protective grids or grills for the purpose specified.

4. An ejector for a pneumatic breakwater according to Claim 2 including a flanged sleeve valve slidable on the outer tube and operative under predetermined conditions to obturate the space between the upper end of such tube and the top of the container temporarily to suspend the siphon action.

5. An ejector for a pneumatic breakwater constructed and adapted to operate substantially as described.

6. A pneumatic breakwater substantially as described.

7. A method of reducing waves in bodies of liquid such as sea water substantially as described.

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PROVISIONAL SPECIFICATION.

Improvements in Artificial Breakwaters.

We, PNEUMATIC BREAKWATERS LIMITED, of 9 Upper Grosvenor Street, London, W.1, a Body Corporate duly organised under the laws of Great Britain, do hereby declare this invention to be described in the following statement :—

This invention relates to artificial breakwaters that is to say to devices for reducing sea waves and swell by interposing air bubbles in the path of wave motion.

Air bubbles are considered to be effective for this purpose only insofar as they create gross discontinuities in the water, in the form of eddies whose velocity and magnitude are of the same order as that of the movements of water in orbital wave motion. In order to create such conditions in the water it is necessary to generate large bubbles, that is to say bubbles substantially larger than are formed at an air nozzle through which air is being discharged continuously.

In the present invention the basic ingredients of an artificial or pneumatic breakwater are as follows : a supply of air from a compressor is conveyed to the sea bottom through a corrosion resisting pipe of suitable bore. This pipe rests on the sea bottom ; along its length, that is to say in the zone in which wave reduction is required the pipe is fitted with adjustable valves spaced some three feet apart. The function of these valves is to provide, at the specified intervals, an air discharge which is controllable and constant for each outlet, notwithstanding the effects of pressure drop in the length of pipe, or differences in hydrostatic pressure caused by variations in the contour of the sea bottom. The valves terminate in jets or outlets which project vertically from the main pipe.

Over each of these jets is placed, on supporters, a container, vessel or can, of cylindrical or rectangular cross section, a particular feature of which is that the upper end of the can is closed, while the lower end is open to the sea. The can is also fitted with a discharge pipe arranged in such a manner as to operate like an inverted siphon. The said pipe is broadly speaking an unsymmetrical U tube. One limb of the U perforates the top of the can, while the other limb terminates just short of the inside of the said top. The bottom of the U tube extends down nearly but not quite as far as the open bottom of the can.

The operation of this device is as follows. A steady supply of air is discharged from the main pipeline through the adjustable valve into the open bottom of the can, and the bubbles naturally rise to the top of the enclosed space. (The operation is described commencing with the can and U tube surrounded by and full of sea water.) The rising bubbles displace the water in the can, which flows out at the open bottom of the can, and at the same time the level of water in one limb of the U tube is equally depressed. When the can is nearly full of air, and when the level of water in the U tube has fallen to the bottom of the U, an escape of air occurs up that limb of the U tube which perforates the top of the can and gives

access to the sea above the can. The escaping air rapidly entrains the water in this limb, which is discharged and followed by the entire air content of the can in one brisk discharge. The air is of course forced out of the can via the syphon by the hydrostatic pressure of the ambient water, which instantly flows up into the can through its open bottom, as the air is displaced. The cycle then recommences. Be it noted that the steady air discharge from the jet is taking place all the time, but at a rate which is adjusted to cause the can to take say five times as long to fill with air as to discharge through its syphon.

In the above manner a steady discharge of air is converted without the aid of moving parts into an intermittent discharge of air in large packages, the frequency of which can be controlled either by adjustment of the valves on the main airline, or by variation of the applied pressure in the main line.

One embodiment of the invention will be described with reference to the accompanying drawings in which :

Figure 1 is an elevation view, while

Figure 2 is a plan view of the discharge apparatus.

Referring now to the drawings a cylindrical container 1 is supported by legs 2 above an air supply pipe 3. The container 1 is open at its lower end and closed at its upper end except for an aperture 4. An air valve 5 is situated on top of the supply line 3 such that it is able to discharge air into the open end of the container 1. A U-shaped siphon tube has one limb 7 which is connected to the aperture 4 and another shorter limb 8 which terminates just below the top of the container. The U of the tube is situated just above the bottom of the container.

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805,789 COMPLETE SPECIFICATION
1 SHEET

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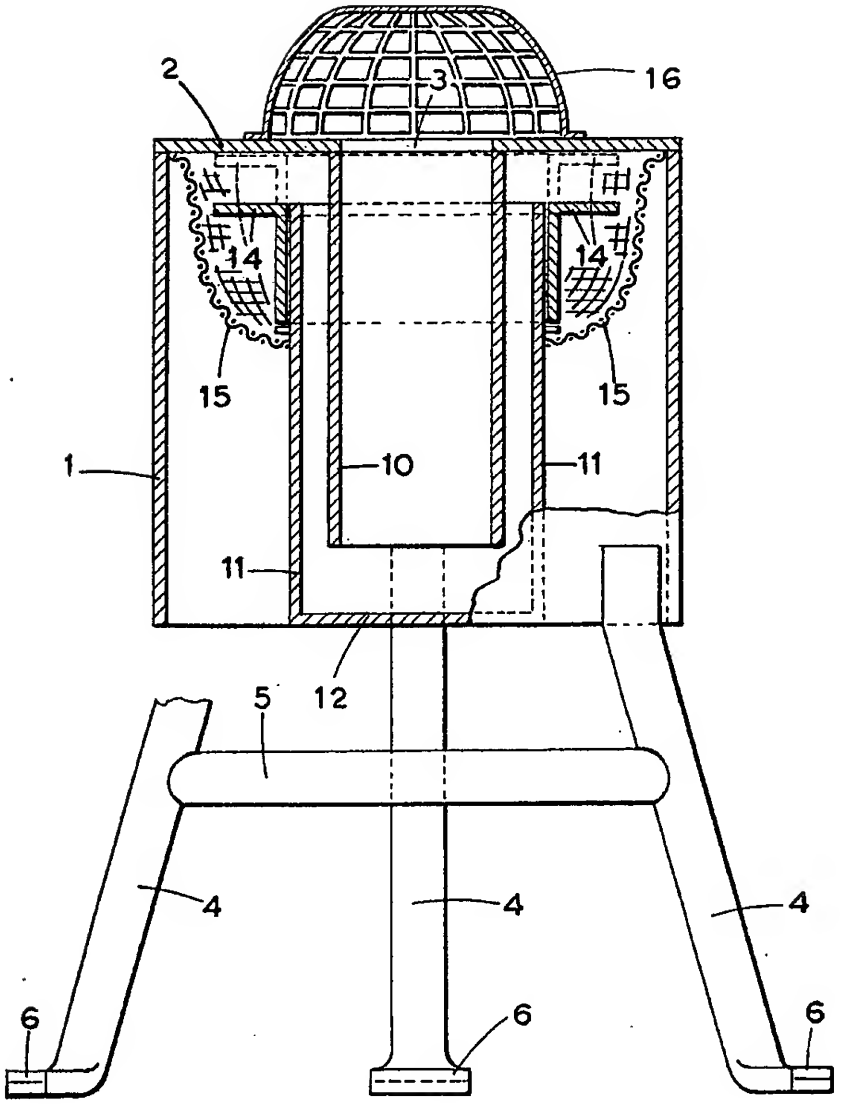

805,789 PROVISIONAL SPECIFICATION
1 SHEET

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FIG. 1.

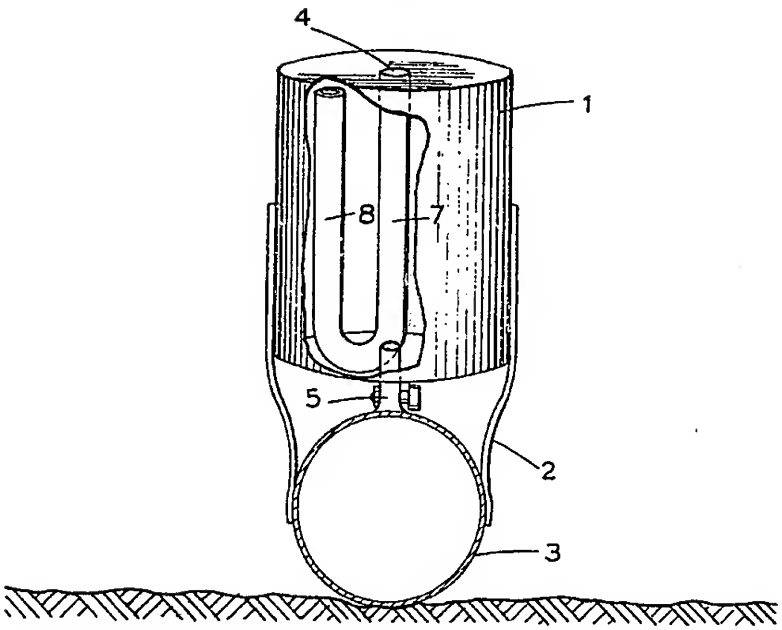

FIG. 2.